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## **BANDWIDTH BOOSTER FOR AGING PRINTER ASICS**

### **Background of the Invention**

#### **1. Field of the Invention**

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This invention generally relates to the field of printer systems, and more particularly relates to a circuit for increasing the bandwidth for aging printer print engines and related ASICs.

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#### **2. Description of Related Art**

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In today's fast paced technology markets, products are rapidly being developed to be faster and more powerful. The design of printers is no exception. Print engines are constantly being updated to allow for more pages printed per minute and better quality printing. In these printers, often an Application Specific Integrated Circuit (ASIC) drives

the print engine. When a new, faster print engine is developed, usually a new version of the ASIC must also be created as the current generation of printer ASICs may not have enough bandwidth to drive the faster print engine at the rated speed. Sometimes the bandwidth requirement for the faster print engine is just over the current ASIC's limit, thus requiring a new printer ASIC. The development of ASICs requires the dedication of much time, money, and resources.

Therefore a need exists to overcome the problems with the prior art as discussed above, and particularly for a method of increasing the bandwidth of aging printer engines and related ASICs.

### Summary of the Invention

According to a preferred embodiment of the present invention, a method triggers a printer to receive a first signal from a print engine, indicating the initiation of the transmission of print data; transmits a shorter signal to a printer ASIC, in response to receiving a signal; receives a line of data to be printed from the printer ASIC; receives a second signal from the print engine; transmits a second shorter signal to the printer ASIC, in response to receiving a signal; receives a second line of data to be printed from the

printer ASIC; and transmits the first line of data to the print engine. This allows a slower printer ASIC to be used with a faster print engine.

### **Brief Description of the Drawings**

5           FIG. 1 is a block diagram illustrating a printing system in accordance with a preferred embodiment of the present invention.

10           FIG. 2 is a more detailed block diagram showing a printer in the system of FIG. 1, according to a preferred embodiment of the present invention.

15           FIG. 3 is a more detailed block diagram showing a bandwidth booster in the printer of the system of FIG. 1, according to a preferred embodiment of the present invention.

20           FIG. 4 is an exemplary timing diagram illustrating the timing sequence of a bandwidth booster, a printer ASIC, and a print engine.

          FIG. 5 is an operational flow diagram illustrating an exemplary operational sequence for the system of FIG. 1, according to a preferred embodiment of the present invention.

## Description Of The Preferred Embodiments

The present invention, according to a preferred embodiment, overcomes problems with the prior art by placing a bandwidth booster between the printer ASIC and the print engine. Since data to the printhead **206** does not run from Beam Detect (BD) to BD, there is some dead time at the start and the end of each scan line. A printer ASIC normally would not be allowed to transfer data during those dead times due to timing constraints from the print engine. The bandwidth booster enables the ASIC to transfer data during those dead times and thus effectively increases the bandwidth of the ASIC. This improves the bandwidth limitation and extends the life of the current ASICs.

FIG. 1 illustrates an exemplary printer system according to a preferred embodiment of the present invention. The printer system **100** includes a printer **106** communicatively coupled to a computer system **102** via a local area network interface **104**. The local area network interface **104** may be a wired communication link or a wireless communication link. The printer **106** may also be communicatively coupled with the world-wide-web, via a wide area network interface (not shown) via a wired, wireless, or combination of wired and wireless local area network communication links **104**. Alternatively, the printer **106** may also be communicatively coupled locally to the computer system **102**.

Each computer system **102** may include, inter alia, one or more computers and at least a computer readable medium **110**. The computers preferably include means for reading and/or writing to the computer readable medium **110**. The computer readable medium **110** allows a computer system to read data, instructions, messages or message packets, and other computer readable information from the computer readable medium **110**. The computer readable medium **110**, for example, may include non-volatile memory, such as Floppy, ROM, Flash memory, Disk drive memory, CD-ROM, and other permanent storage. It is useful, for example, for transporting information, such as data and computer instructions, between computer systems. Furthermore, the computer readable medium **110** may comprise computer readable information in a transitory state medium such as a network link and/or a network interface, including a wired network or a wireless network, that allow a computer to read such computer readable information.

The printer **106**, according to the present example, includes a controller/processor unit **208** (shown in FIG. 2), which processes instructions, performs calculations, and manages the flow of information through the printer **106**. Additionally, the controller/processor **208** is communicatively coupled with program memory **218** which may contain a self-analysis module **220**. The controller/processor unit **208** manages resources, such as the data stored in data memory **222**, the scheduling of tasks, the operation of a printer engine **202**, a bandwidth booster **210** (as will be discussed in more

detail below) and a printer ASIC **204**. The controller/processor unit **208** may also manage a communication network interface **216** for communicating with the network link **104**, and a computer-readable medium drive **214**. Additionally, the controller/processor unit **208** also manages many other basic tasks of the printer **106** in a manner well known to those of ordinary skill in the art.

In a preferred embodiment, the controller/processor unit **208** is communicatively coupled to the bandwidth booster **210** and to the printer ASIC **204**. The bandwidth booster **210** is communicatively coupled to the print engine **202** and to the printer ASIC **204**. The print engine **202** may include a fusing or drying system (not shown) and a printhead **206**. The printhead **206** is used to apply toner or ink **212** to paper **108**. Data memory **222** is communicatively coupled to the controller/processor unit **208** and may contain a queue of print jobs **224**, and a configuration database **226**.

FIG. 3 illustrates an exemplary bandwidth booster **210** of the printer **106** in the system of FIG.1, according to a preferred embodiment of the present invention.

An engine interface **312** is communicatively coupled to the printer engine **202** and a dual port FIFO (First In First Out) device **310**. The engine interface receives a real Beam Direct (BD) **300** signal from the printer engine **202** (shown in FIG. 2) and transmits

Engine Video Data Out (VDO) 306, received from the FIFO 310, to the printer engine 202 to be printed. An ASIC interface 308 is communicatively coupled to the printer ASIC 204 (shown in FIG. 2) and also to the FIFO 310. The ASIC interface 308 transmits a pseudo BD signal 302 to the printer ASIC 204 in response to the engine interface receiving a longer real BD signal 300. The ASIC interface 308 receives ASIC VDO data 304 from the printer ASIC 204 and transmits this data to the FIFO 310. An external clock 314 is communicatively coupled to the bandwidth booster 210 and controls the timing sequence.

FIG. 4 is an exemplary timing diagram illustrating the timing sequence of a bandwidth booster 210, a printer ASIC 204, and a print engine 202. Since data to the printhead 206 does not run from Beam Detect (BD) to BD, there is some dead time at the start and the end of each scan line. A printer ASIC 204 normally would not be allowed to transfer data during those dead times due to timing constraints from the print engine 202. The bandwidth booster 210 enables the printer ASIC 204 to transfer data during those dead times and thus effectively increases the bandwidth of the ASIC 204. This is a significant advantage of the present invention that is not available in any known prior art printer system.



In a preferred embodiment, a bandwidth booster **210** is placed between the printer ASIC **204** and the print engine **202**. The function of the bandwidth booster **210** is to buffer the print data (shown in FIG. 4 as ASIC VDO **304**) and generate a pseudo BD **302** to the printer ASIC **204** for every real BD **300** from the print engine **202**. The time between each pseudo BD **302** will be same as the real BD **300**. Unlike a real print engine **202**, the bandwidth booster **210** can place much less dead time on the pseudo BD **302**, thus the same amount of data can be transferred over longer period of time and, effectively, increases the bandwidth of the printer ASIC **204**. The bandwidth booster **210** then transfers the buffered data (shown in FIG. 4 as Engine VDO **306**) to the print engine **202** at a higher speed. This allows a slower printer ASIC **204** to be used with a faster print engine **202**.

For example a fast print engine **202** requires the following bandwidth:

$$\text{Data}/(\text{read tBD} - \text{tDT1} - \text{tDT2}) = \text{xMhz}.$$

The xMhz is over the printer ASIC's **204** limit without the bandwidth booster **210**. With the bandwidth booster **210**, the tDT1 and tDT2 can be ignored:

$$\text{Data}/\text{pseudo tBD} = \text{yMhz}, \text{ where yMhz is less than xMhz}.$$

Depending on the speed of the print engine **202**, the bandwidth difference between xMhz and yMhz may make the difference between using a current ASIC **204** or designing a new ASIC.

FIG. 5 is an operational flow diagram illustrating an exemplary operational sequence for the system of FIG. 1. The system enters the sequence at step 502, wherein the engine interface 312 receives a real BD signal 300 from the printer engine 202. At step 504, the ASIC interface 308 generates a shorter pseudo BD signal 302 and transmits the pseudo BD 302 to the printer ASIC 204. In response to receiving the pseudo BD 302, at step 506, the printer ASIC 204 sends a first line  $n$  of data to the ASIC interface 308. The data is stored in a dual port FIFO 310. The engine interface 312 then receives the next real BD 300 from the print engine 202, at step 508. Again, at step 510, the ASIC interface 308 sends a pseudo BD 302 to the printer ASIC 204 and the printer ASIC 204, at step 512, begins sending the next line of data ( $n+1$ ) to the ASIC interface 308. At step 514, the buffered line  $n$  data stored in the FIFO 310 is sent to the engine interface 312 and then to the printer engine 202 to be printed. The process is repeated, at step 516, until all lines of data in a print job 224 have been printed.

The present invention can be realized in hardware, software, or a combination of hardware and software. Any kind of printer system - or other apparatus adapted for carrying out the methods described herein - is suited. A typical combination of hardware and software could be a general purpose printer system with a computer program that, when being loaded and executed, controls the printer system such that it carries out the methods described herein.

The present invention can also be embedded in a computer program product, which comprises all the features enabling the implementation of the methods described herein, and which - when loaded in a printer system - is able to carry out these methods. Computer program means or computer program in the present context mean any  
5 expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following a) conversion to another language, code or, notation; and b) reproduction in a different material form.

10 Although specific embodiments of the invention have been disclosed, those having ordinary skill in the art will understand that changes can be made to the specific embodiments without departing from the spirit and scope of the invention. The scope of the invention is not to be restricted, therefore, to the specific embodiments, and it is intended that the appended claims cover any and all such applications, modifications, and  
15 embodiments within the scope of the present invention.

What is claimed is: